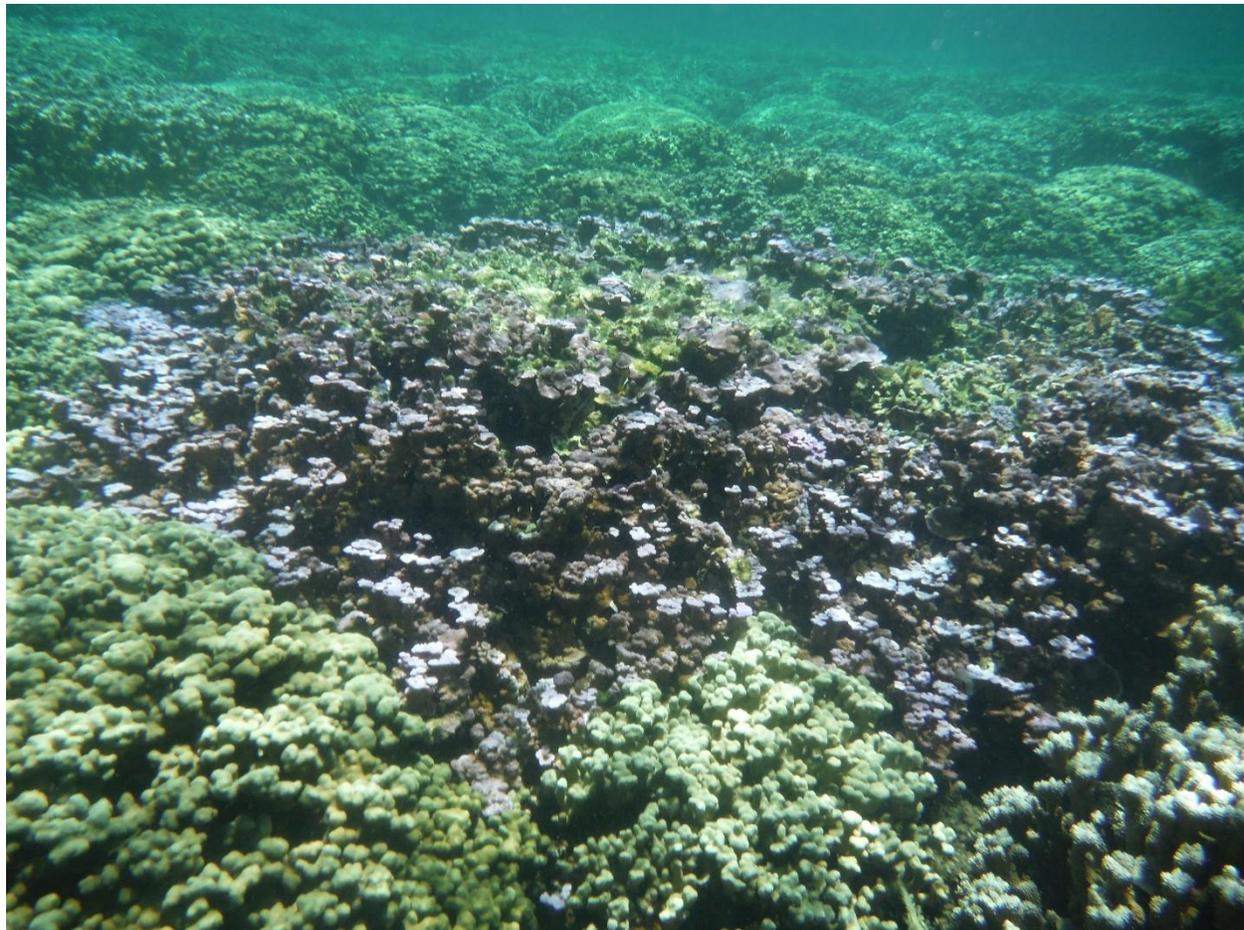


University of Hawaii at Manoa

Biology 403: Field Problems in Marine Biology



Characterizing the unique habitat of *Montipora dilatata*

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Abstract

Montipora dilatata is a rare coral that has been found only in Kāneʻohe Bay, Hawaii, and on Maro Reef in the Northwestern Hawaiian Islands (Forsman *et al.* 2010). In recent decades *M. dilatata* has been decreasing in abundance and is now considered a Species of Concern (SOC) by the National Oceanic Atmospheric Administration (NOAA) and the National Marine Fisheries Services (NMFS). In this study, known *M. dilatata* colonies in Northern Kāneʻohe Bay were surveyed to determine if the environmental parameters of the colonies are similar on different reefs of similar size and location. The confirmed colonies were compared with random points on a nearby reef on which *M. dilatata* had not been previously identified. A visual survey was completed on this reef which resulted in several potential *M. dilatata* colonies being identified based on morphology. Community structure, water depth, pH, salinity, spatial complexity, and colony size were compared between reefs using t-test analyses. These results could indicate the likelihood of the unidentified colonies being *M. dilatata* based on similarities and differences between the three studied reefs.

Introduction

Kāneʻohe Bay, Hawaiʻi is a unique environment that has provided a habitat for several Species of Concern (SOC) (Roberts & Hawkins, 1999). Among these SOCs is *Montipora dilatata*, a coral that has only been found in Kāneʻohe Bay and on Maro Reef in the Northwestern Hawaiian Islands (Forsman *et al.* 2010). In recent decades *M. dilatata* has been decreasing in abundance and is now considered a Species of Concern (SOC) by the National Oceanic Atmospheric Administration (NOAA) and the National Marine Fisheries Services (NMFS). Reasons for the decline of this species are not fully understood but are suspected to be caused by its low resistance and high sensitivity to bleaching and other environmental conditions (Jokiel and Brown, 2004). It has been well documented that all corals in Hawaiʻi have an upper thermal limit of 2 °C above the summer maximum (Coles, 1975). Kāneʻohe Bay also has a history of environmental variability and anthropogenic impacts (i.e. sewage discharge, dredging, etc.) which have created a challenging place for a susceptible coral species to thrive (Hunter & Evans, 1995). In previous studies these effects have been exhibited more throughout the southern part of Kāneʻohe Bay where there is little mixing, extensive sedimentation, and nutrient input

(Hunter & Evans, 1995). This poses an explanation for *M. dilatata* being exclusively confirmed on reefs in Northern Kāneʻohe Bay.

Current research on *M. dilatata* is limited and difficult due to its lack of morphological distinction from other *Montipora* species. The wide range of phenotypic plasticity that *M. dilatata* exhibits disallows for appropriate identification. *M. dilatata* colonies can have a purple or chocolate-like brown color; its morphology can be encrusting, plating, or branching (DePartee *et al.*, 2011). Moreover, researchers have been unable to find any differences in microscopic morphology or DNA comparison between *M. dilatata* and its closest relatives *Montipora flabellata* and *Montipora turgescens* (Forsman *et al.*, 2010). The challenge with attempting to clarify the taxonomy of certain corals is that morphologically similar species are often able to reproduce (Willis *et al.*, 2006). This problem leads to ambiguous designations; for instance, a species like *M. dilatata* might exist as its own lineage, an ecomorph, or a hybrid of two converging lineages (Forsman *et al.*, 2010). Coupled with its Species of Concern designation by NOAA, these issues have made current research on *M. dilatata* in Kāneʻohe Bay extremely important in order to determine an accurate identification and consequentially to guide future management.

The decline of *M. dilatata* could be a result of certain environmental stressors occurring in the bay (Jokiel & Brown, 2004). This species is particularly sensitive to thermal stressors, as well as changes in salinity from freshwater sources (Faxneld *et al.*, 2010; Williamson *et al.*, 2011). Past studies have determined that corals and other marine life are sensitive to pH fluctuation (Caldeira *et al.*, 2007; Jokiel *et al.*, 2008). By studying these factors and determining which conditions *M. dilatata* thrives in, we can indicate which environments would be best suited for the expansion and success of the species in the future. Patch reef size can also

influence which coral species make up the community (Huntington and Lirman, 2012), however the three reefs studied in this project are of similar size and are located in close proximity to each other to reduce other confounding variables. The Biology 403 class in 2012 determined that a significant positive correlation existed between warmer water temperature and *M. dilatata* occurrence. They also found significant results suggesting that reefs with a lower salinity were more likely to have *M. dilatata* colonies. These results were not expected based on other research which identifies high temperature and low salinity as stressors for endangered corals (Faxneld et al. 2010; Williamson et al. 2011). Additional studies with these parameters may lead to a stronger explanation for these occurrences with regards to *M. dilatata* prevalence.

The purpose of this project was to determine whether or not *M. dilatata* has a preferred environment in which it thrives. In 2004, a tank experiment performed at the Waikiki Aquarium recorded growth of an *M. dilatata* fragment taken from Kāneʻohe Bay (Delbeek *et al.* 2007). However, growing coral in a controlled tank cannot mimic the possible factors in the field. Environmental levels must be measured in order to properly characterize *M. dilatata* growth. This study proposes to utilize field investigations to describe the environmental characteristics where *M. dilatata* exists by comparing several parameters on reefs with confirmed *M. dilatata* colonies in order to see if there are any trends. These trends were then compared to a reef without confirmed *M. dilatata* in order to evaluate similarities and differences between the two. Environmental factors as well as community structure were measured by recording water depth, pH, salinity, spatial complexity, and colony size. For this research, it was hypothesized that H_0 : The environmental parameters found on reefs with *M. dilatata* are not different from parameters on reefs without confirmed *M. dilatata*.

Materials and Methods

The scope of this study is Northern Kāneʻohe Bay. Two reefs that have confirmed *Montipora dilatata* colonies were visited; reef 44 and 47. Both reefs have three confirmed colonies, which have been studied in previous years during the Biology 403 summer class. Reef 46 lies between these reefs and only potential *M. dilatata* colonies have been identified previously. Three random points were generated for reef 46. The basis for investigating these three reefs is to compare the parameters of two reefs with *M. dilatata* and the one reef without *M. dilatata*. For each colony on reefs 44 and 47 and three random points on reef 46, the environmental factors and community structure was investigated.

Community Structure

Community structure was measured using three 10 m transects in a Mercedes formation (facing the top portion of the Mercedes towards north) on each of the six colonies and three random points (Fig. 1) (DePartee, 2011). The species under each meter mark of the transect was recorded to determine species composition. Rugosity chains were deployed along ten meters of each transect. Chains were marked with flagging tape every meter and allowed to follow the contour of the reef creating a topographical index which was used to estimate spatial complexity. This index was calculated by dividing the linear distance of the rugosity chain by the length of the transect (McCormick, 1994).

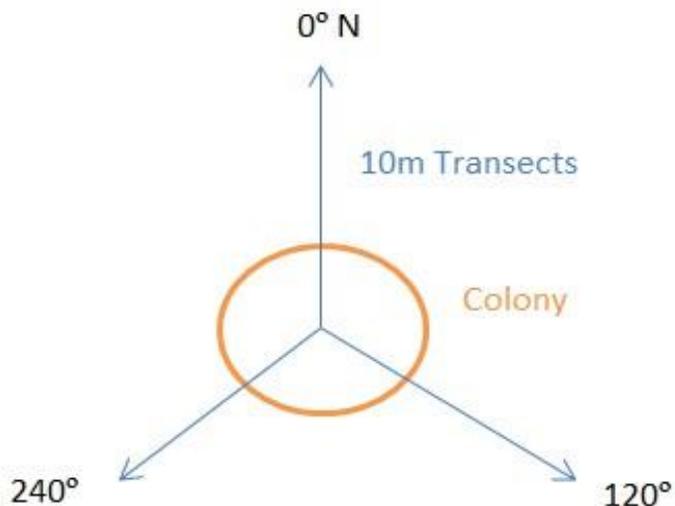


Figure 1. The Mercedes formation which was deployed on each coral colony and three random points on reef 46.

Temperature and Light

Temperature and light measurements were recorded by deploying HOBO pendant™ loggers. Loggers were deployed at each of the six colonies on reef 44 and reef 47 and the three random points on reef 46. The loggers were set to record at ten min intervals and left out for a period of 48 hrs to determine if temperature and light vary among reefs found with and without *M. dilatata* colonies. Loggers were calibrated at 0°C and 33-35°C.

pH and Salinity

Water samples were collected at reefs 44, 46, and 47. At each reef, three samples were taken, one at each of the three colonies on reefs 44 and 47 and one at each of the three random points on reef 46. The samples were collected in falcon tubes, approximately two inches above the middle of the colony or above the substrate at the random points. Tubes were carried in the dive float submerged in water to maintain water temperature. The pH and salinity were recorded at each reef using the PCSTestr 35 Multi-Parameter tester and a standard refractometer. Before and after each measurement, the devices were rinsed using deionized water. The PCSTestr 35 Multi-Parameter tester was calibrated each night before field work using NIST standardized

buffers (pH 4.00, 7.00, and 10.00). This study tested pH and salinity at each site surveyed to see if any differences or similarities could be distinguished between reefs.

Water Depth

Water depth was measured using transect lines placed vertically from the surface of the water to the top of the coral head. That measurement was then adjusted based on the tidal fluctuations.

Colony Size

Size of the coral colonies were estimated by measuring the colony perimeter. Transects were laid at the base of the colonies, and the line was laid along the contour of the edge of the coral.

Statistical Analyses

Data was analyzed by comparing reef 44 and reef 46 parameters using a two-sample t-test to determine how two reefs with confirmed *M. dilatata* compare to one another and allow for characterization of *M. dilatata*'s optimal environment. Each reef's parameters were compared to reef 46 to see how reefs with and without *M. dilatata* differ.

Table 1. The GPS locations of each colony and random points surveyed.

Site	Colony	Latitude	Longitude
44	12	21.47705	-157.83171
44	16	21.47767	-157.83221
44	14	21.4774	-157.83192
47	3	21.48091	-157.83269
47	15	21.48166	-157.83299
47	30	21.48121	-157.83351
46	Random Point 1	21.47946	-157.83429

46	Random Point 2	21.47921	-157.83392
46	Random Point 3	21.47935	-157.83325

Results

Data points taken at reef 44, reef 47, and reef 46 were compared against each other using two-way t-tests assuming equal variance. The t-critical values were found using a given alpha (α) level of 0.05. The t-test results for each of the parameters tested showed significant results in three instances. The *Montipora dilatata* colonies on reef 44 had a significantly greater rugosity than reef 47. The colonies on reef 44 also showed a significantly greater rugosity than the random points on reef 46. The *M. dilatata* colonies on reef 44 had a significantly lower depth than the colonies on reef 47.

Rugosity

The range of rugosity from the three *M. dilatata* colonies studied on reef 44 was 1.34 to 1.98. The range of rugosity between the three random points at reef 46 was 1.13 to 1.46. The range of rugosity between the three colonies on reef 47 was 1.12 to 1.37.

Mean rugosity of *M. dilatata* colonies on reef 44 ($\bar{x} = 1.61$) was significantly greater than the mean rugosity of *M. dilatata* colonies on reef 47 ($\bar{x} = 1.20$) (Two-tailed t-test; H_0 : reef 44 = reef 47; $t_{stat} = 4.82$; $df = 16$; $p = <0.001$). Mean rugosity of *M. dilatata* colonies on reef 44 ($\bar{x} = 1.61$) was significantly greater than the mean rugosity at random points on reef 46 ($\bar{x} = 1.34$) (Two-tailed t-test; H_0 : reef 44 = reef 46; $t_{stat} = 3.04$; $df = 16$; $p = 0.01$). Mean rugosity of *M. dilatata* colonies on reef 47 ($\bar{x} = 1.20$) were not significantly different than the mean rugosity at random points on reef 46 ($\bar{x} = 1.34$) (Two-tailed t-test; H_0 : reef 47 = reef 46; $t_{stat} = -3.24$; $df = 16$; $p = 2.12$) (Fig. 2).

Topographical Index of Reefs in Northern Kāne'ōhe Bay

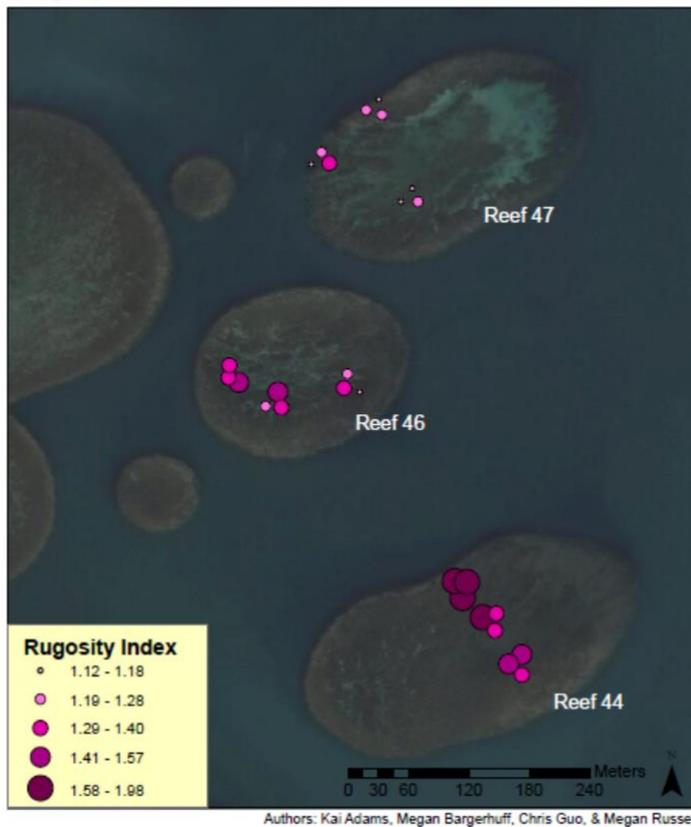


Figure 2. The rugosity index found along each transect.

Community Structure

Each reef had a wide variety of community components. Reef 47 was dominated by *M. capitata* and rubble with slightly less contribution from *M. dilatata* and *P. compressa*. Reef 46 had a similar composition with rubble, *M. capitata*, and *P. compressa* being most commonly found. Reef 44 had the most variety among all three colonies with *P. compressa* and *M. capitata* being dominant (Fig. 3).

Species Composition of Reef Communities in Northern Kāne'ohe Bay

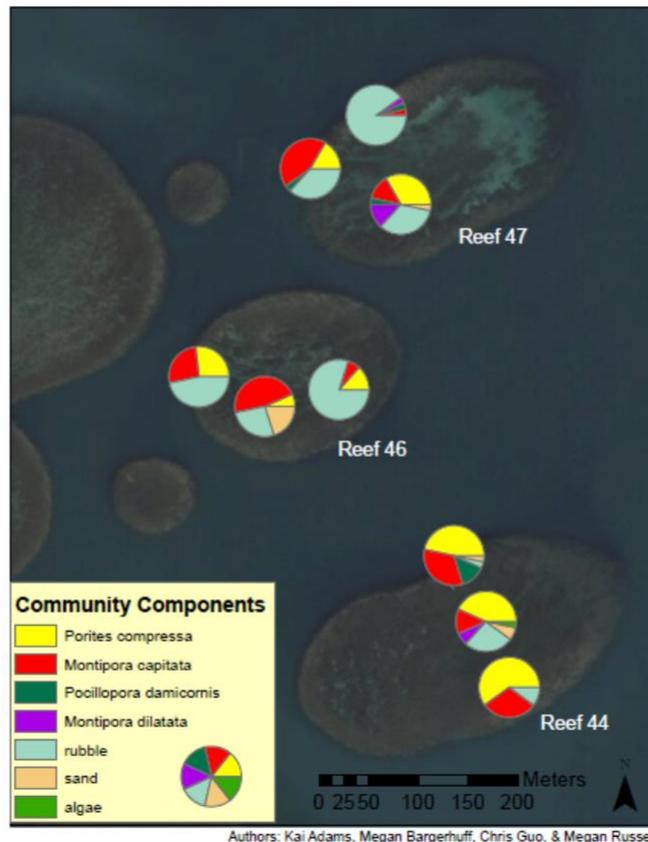


Figure 3. The community composition found at each of the sampling sites.

pH

The range of pH from the three colonies studied on reef 44 was 8.23 to 8.25. The range between the three random points on reef 46 was 8.2 to 8.34. The range between the three *M. dilatata* colonies on reef 47 was 8.26 to 8.34.

Mean pH of water samples taken at *M. dilatata* colonies on reef 44 ($x = 8.24$) was not significantly different than the mean pH of water samples taken at colonies on reef 47 ($x = 8.29$) (Two-tailed t-test; H_0 : reef 44 = reef 47; $t_{stat} = -2.27$; $df = 4$; $p = 0.0856$). Mean pH of water samples taken at *M. dilatata* colonies on reef 44 ($x = 8.24$) was not significantly different than the mean pH of water samples taken at random points on reef 46 ($x = 8.27$) (Two-tailed t-test; H_0 : reef 44 = reef 46; $t_{stat} = 0.730$; $df = 4$; $p = 0.253$). Mean pH of water samples taken at *M.*

dilatata colonies on reef 47 ($x = 8.29$) was not significantly different than the mean pH of water samples taken at random points on reef 46 ($x = 8.27$) (Two-tailed t-test; H_0 : reef 47 = reef 46; $t_{stat} = 0.566$; $df = 4$; $p = 0.301$).

Colony Size

The range of colony size on reef 44 was 4.8 m to 8.4 m. The range of colony size on reef 47 was 4.5 m to 7.2 m.

Mean colony size of *M. dilatata* colonies at reef 44 ($x = 6.13\text{m}$) was not significantly different than the mean colony size of *M. dilatata* colonies at reef 47 ($x = 6.28\text{m}$) (Two-tailed t-test; H_0 : reef 44 = reef 47; $t_{stat} = -0.0992$; $df = 4$; $p = 0.926$) (Fig. 4).

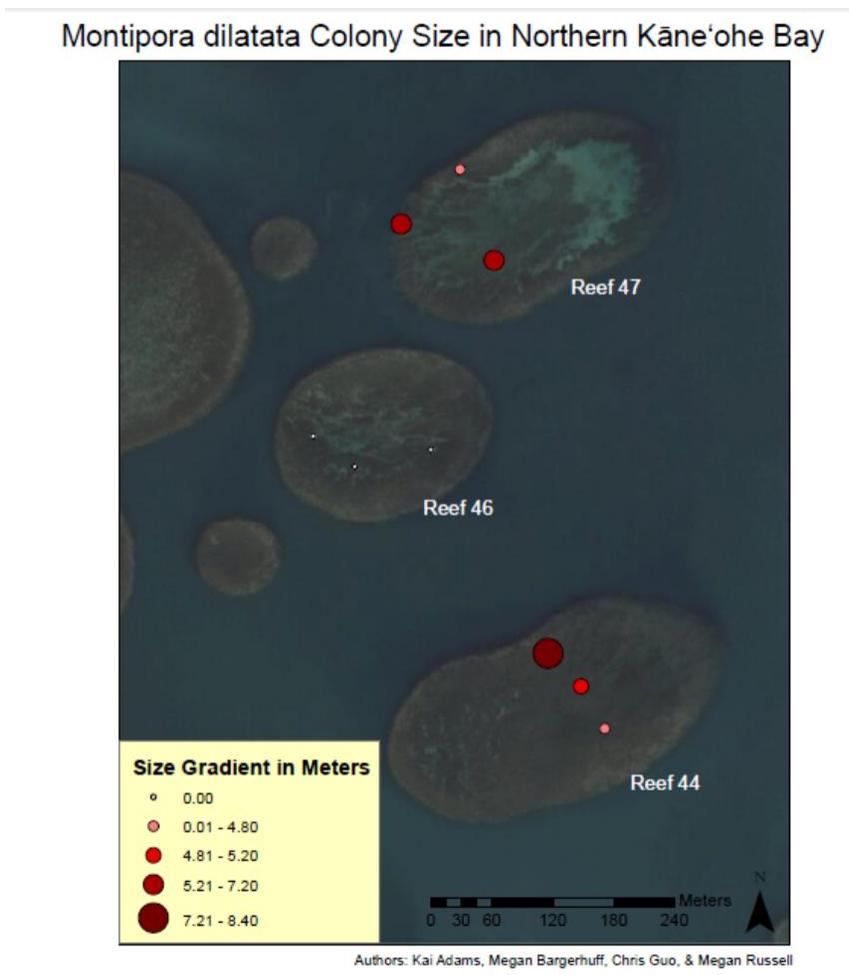


Figure 4. The colony size (m) found at each sampling location.

Depth

The range of depth of the colonies studied on reef 44 was 0.98 m to 1.27 m. The range of depth on the reef 47 colonies was 1.49 m to 2.41 m. The range of depth at the random points on reef 46 was 1.38 m to 2.16 m. These depths were standardized based on tidal fluctuations.

Mean depth of *M. dilatata* colonies on reef 44 ($\bar{x}=1.310\text{m}$) was significantly less than the mean depth of *M. dilatata* colonies of reef 47 ($\bar{x}=1.923\text{m}$) (Two-tailed t-test; H_0 : reef 44=reef 47; $t_{\text{stat}}=-2.831$; $df=4$; $p=.047$). Mean depth of *M. dilatata* colonies on reef 44 ($\bar{x}=1.310\text{m}$) was not significantly different than the mean depth of random points on reef 46 ($\bar{x}=1.743\text{m}$) (Two-tailed t-test; H_0 : reef 44=reef 46; $t_{\text{stat}}=-2.531$; $df=4$; $p=0.065$). Mean depth of *M. dilatata* colonies on reef 47 ($\bar{x}=1.923\text{m}$) was not significantly different than the mean depth of random points on reef 46 ($\bar{x}=1.743\text{m}$) (Two-tailed t-test; H_0 : reef 47=reef 46; $t_{\text{stat}}=0.513959$; $df=4$; $p=0.634$).

Salinity

The range of salinity across all colonies and random points studied on all three reefs was 33 ‰ to 34 ‰.

Mean salinity of *M. dilatata* colonies on reef 44 ($\bar{x} = 33.00$ ‰) was not significantly different than the mean salinity of *M. dilatata* colonies on reef 47 ($\bar{x} = 33.667$ ‰) (Two-tailed t-test; H_0 : reef 44 = reef 47; $t_{\text{stat}} = 2$; $df = 4$; $p = 0.116$). Mean salinity of *M. dilatata* colonies on reef 44 ($\bar{x} = 33.000$ ‰) was not significantly different than the mean salinity of *M. dilatata* colonies on reef 46 ($\bar{x} = 33.667$ ‰) (Two-tailed t-test; H_0 : reef 44 = reef 46; $t_{\text{stat}} = 65536$; $df = 4$; $p = >.05$). Mean salinity of *M. dilatata* colonies on reef 47 ($\bar{x} = 33.667$ ‰) was not significantly different than the mean salinity of *M. dilatata* colonies on reef 46 ($\bar{x} = 33$ ‰) (Two-tailed t-test; H_0 : reef 47 = reef 46; $t_{\text{stat}} = -2$; $df = 4$; $p = 0.116$).

Temperature

The maximum temperature between all colonies on reef 44 was 29.953 °C. Colony 14 on reef 44 was above 29 °C for 4.5 hours between 12:00 pm and 5:30 pm. The max temperature at the random points on reef 46 was 29.053 °C; however, the warmest studied point on this reef was only above 29 °C for a total of 20 minutes for the entire day. The max temperature between the studied colonies on reef 47 was 29.053 °C; however, the warmest colony between these three was only above 29 °C for 10 minutes total in the observed day. The total temperature range for the entire day throughout all three reefs was 24.641 °C to 29.953 °C.

Mean temperature of water samples taken at *M. dilatata* colonies on reef 44 ($x = 27.3$) were not significantly different than the mean temperature of water samples taken at *M. dilatata* colonies at reef 47 ($x = 27.2$) (Two-tailed t-test; H_0 : reef 44 = reef 47; $t_{stat} = -0.975$; $df = 3$; $p = 0.402$). Mean temperature of water samples taken at *M. dilatata* colonies on reef 47 ($x = 27.2$) were not significantly different than the mean temperature of water samples taken at random points at reef 46 ($x = 27.1$) (Two-tailed t-test; H_0 : reef 47 = reef 46; $t_{stat} = 0.380$; $df = 2$; $p = 0.740$). Mean temperature of water samples taken at *M. dilatata* colonies on reef 44 ($x = 27.3$) were not significantly different than the mean temperature of water samples taken at random points at reef 46 ($x = 27.1$) (Two-tailed t-test; H_0 : reef 44 = reef 46; $t_{stat} = 1.16$; $df = 3$; $p = 0.328$).

Temperature and light were measured using HOBO pendant loggers. Readings were collected every ten minutes over a span of 48 hours (Figures 5-11).

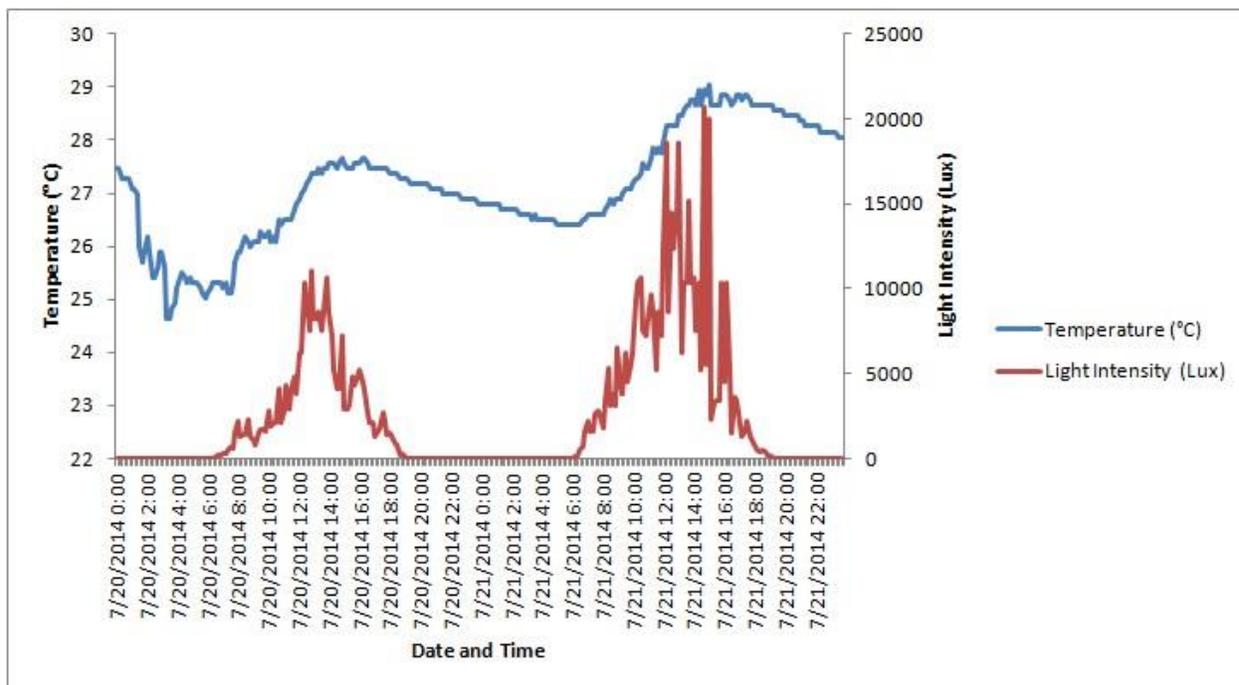


Figure 5. The temperature ($^{\circ}\text{C}$) and light intensity (lux) over 48 hours at reef 47, colony 15.

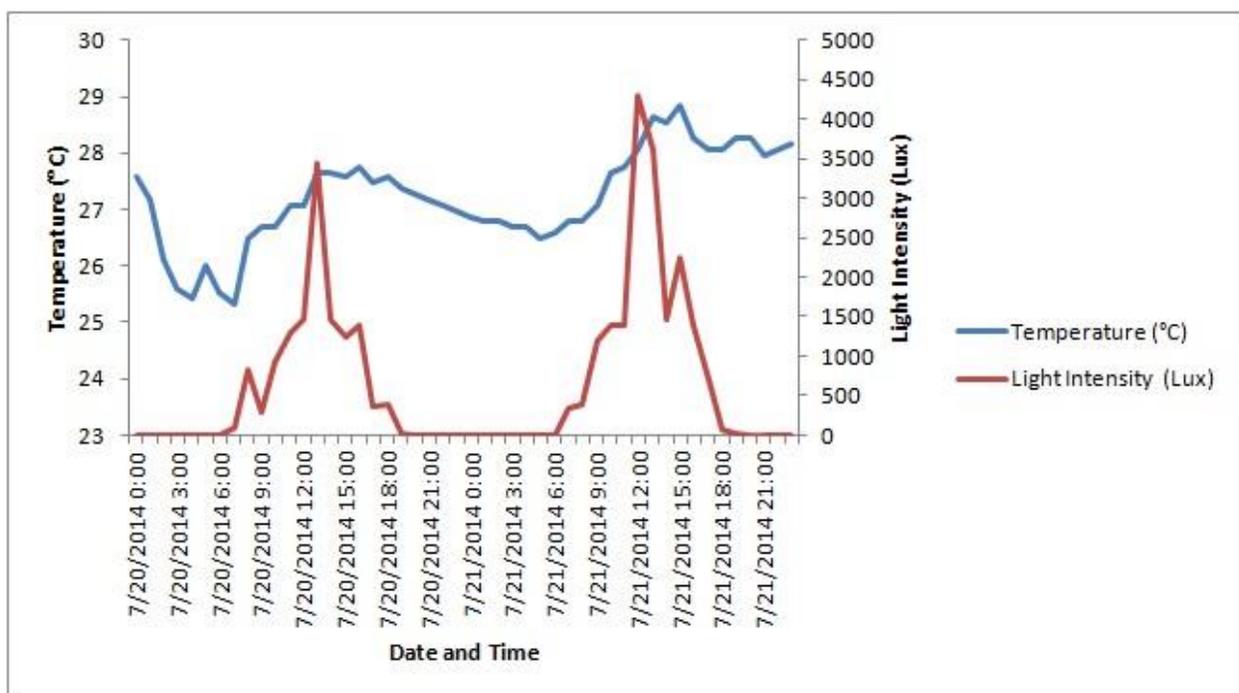


Figure 6. The temperature ($^{\circ}\text{C}$) and light intensity (lux) over 48 hours at reef 47, colony 30.

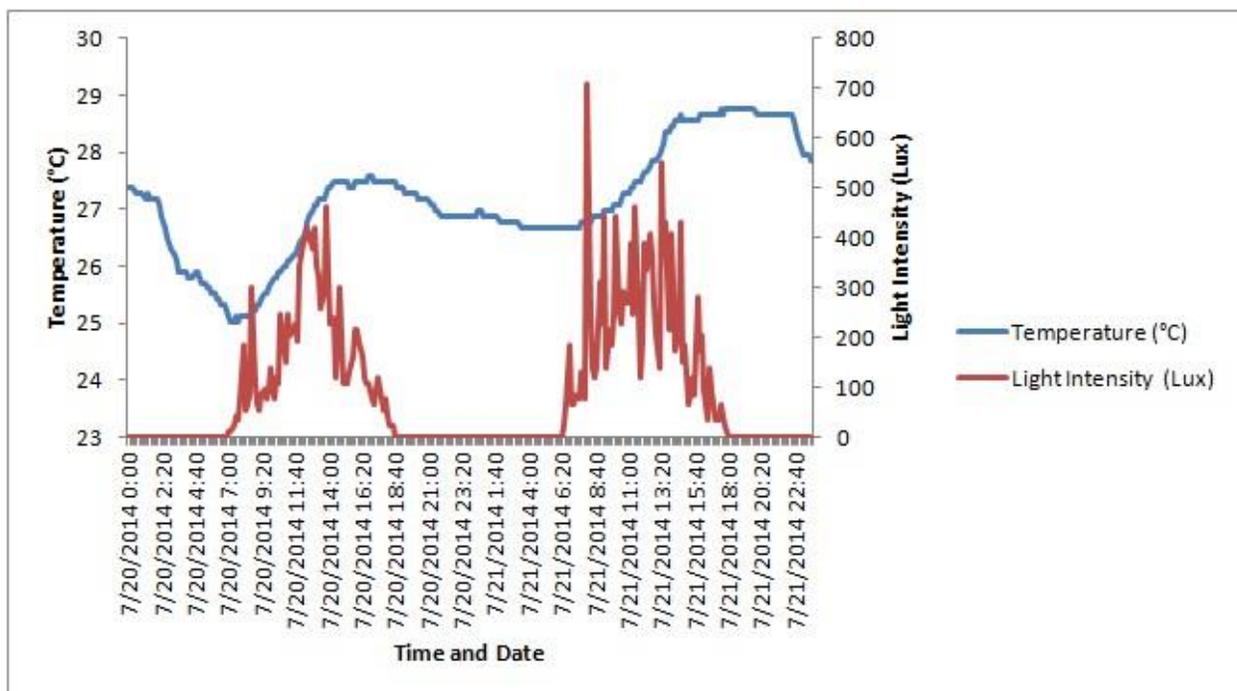


Figure 7. The temperature (°C) and light intensity (lux) over 48 hours at reef 44, colony 12.

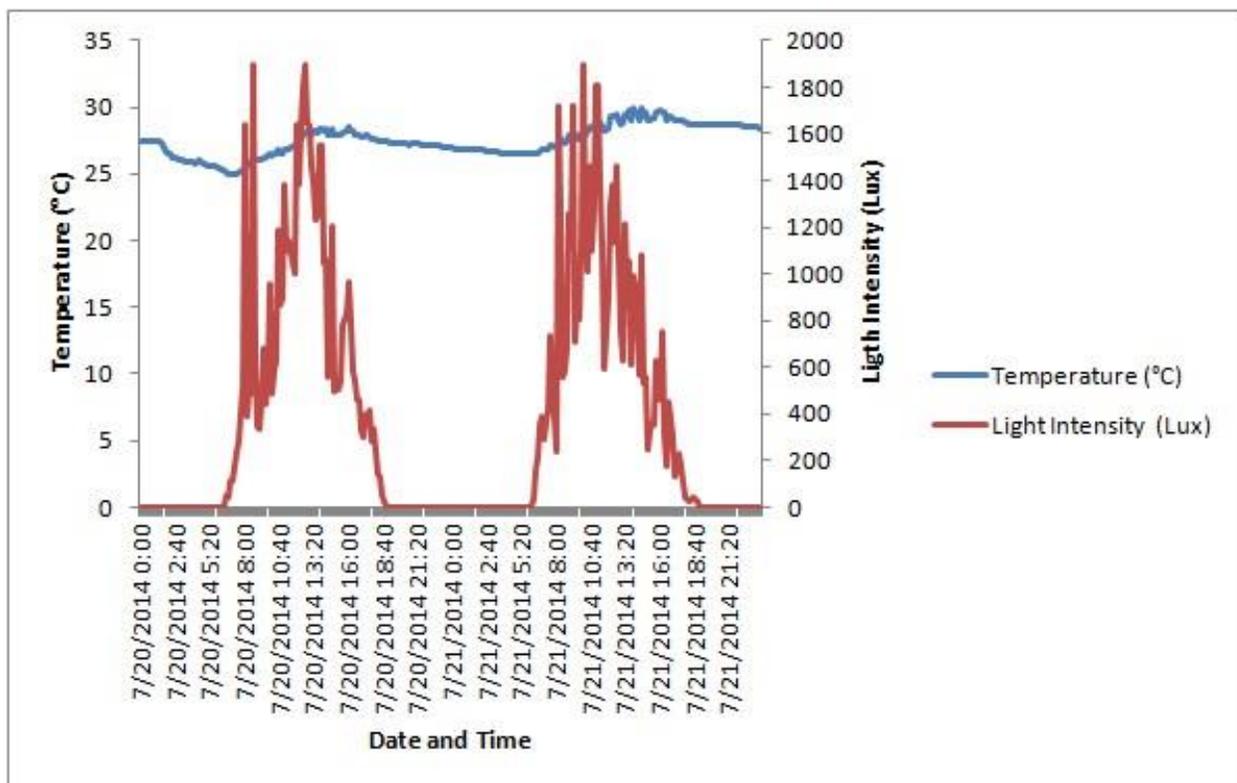


Figure 8. The temperature (°C) and light intensity (lux) over 48 hours at reef 44, colony 14.

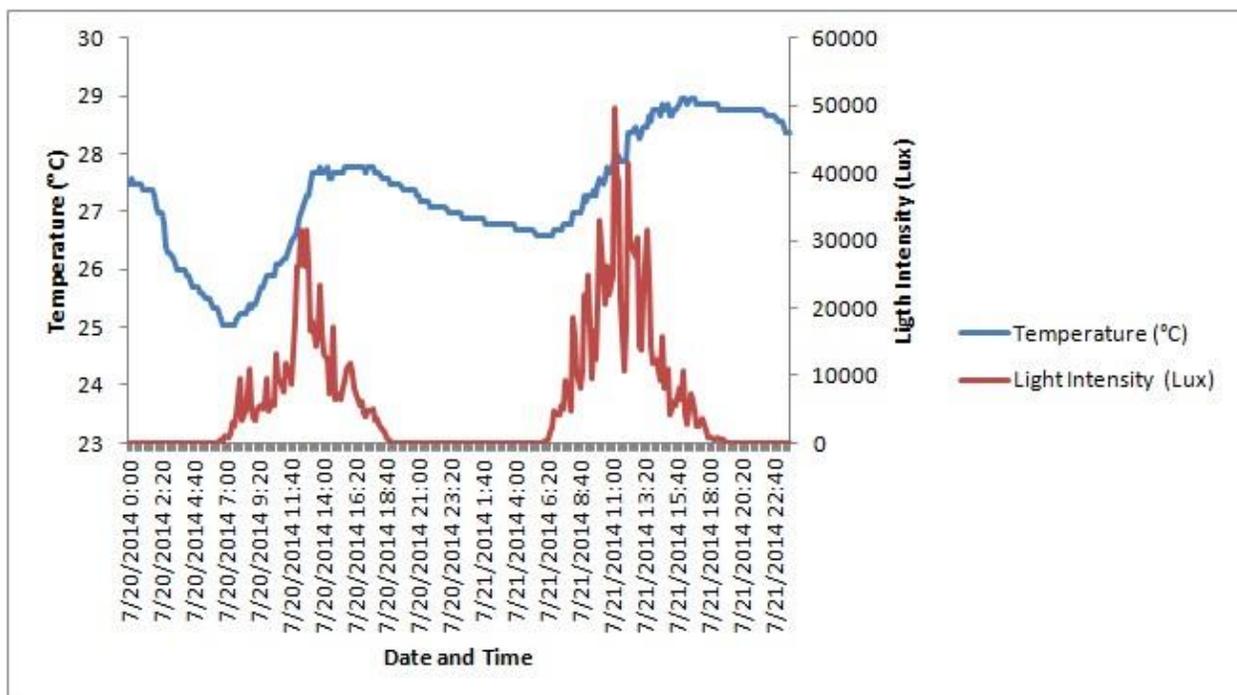


Figure 9. The temperature ($^{\circ}\text{C}$) and light intensity (lux) over 48 hours at reef 44, colony 16.

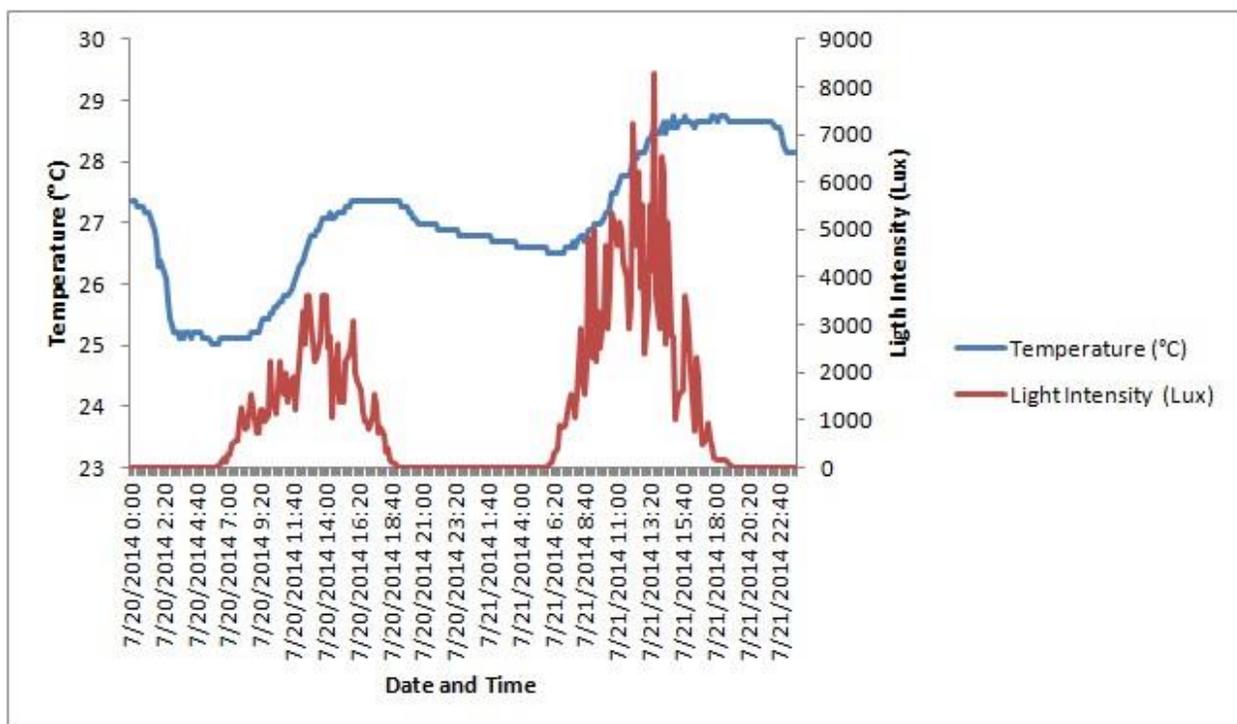


Figure 10. The temperature ($^{\circ}\text{C}$) and light intensity (lux) over 48 hours at reef 46, random point 2.

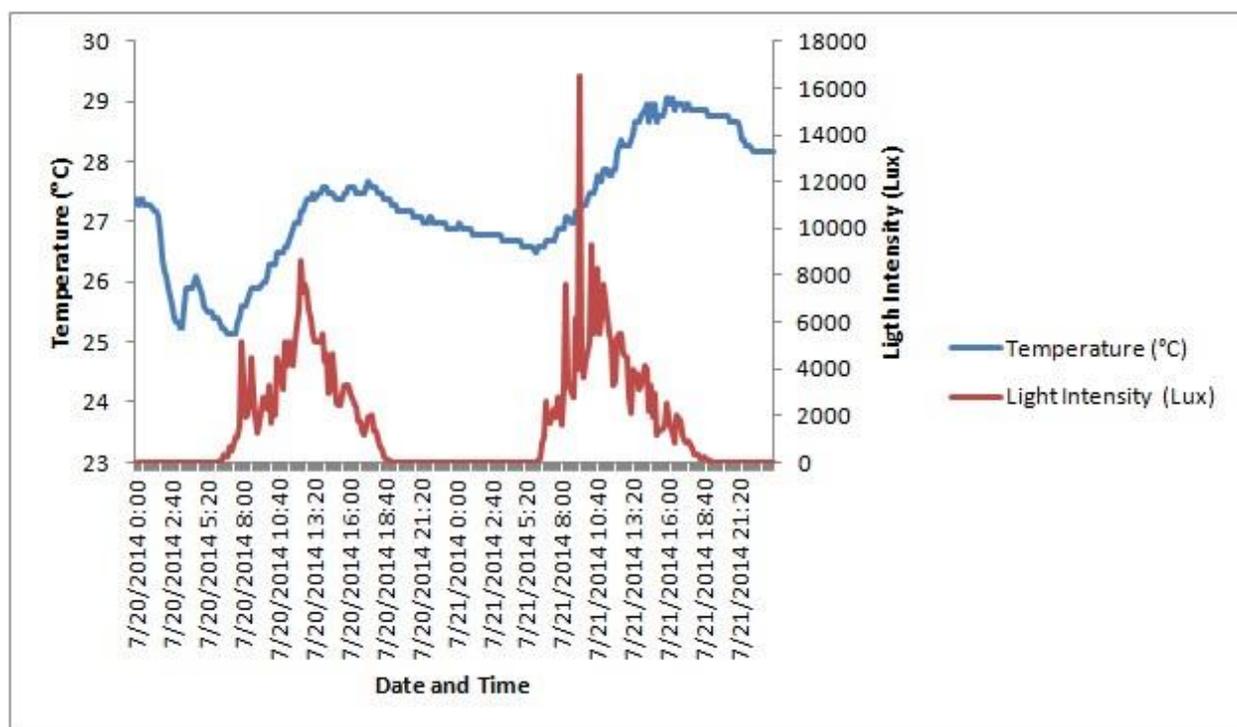


Figure 11. The temperature (°C) and light intensity (lux) over 48 hours at reef 46, random point 3.

Discussion

Montipora dilatata is an important coral in the Kāneʻohe Bay ecosystem according to its designation as a Species of Concern (SOC) by NOAA. It has become vital to conduct surveys in order to protect and conserve this native coral. The purpose of this research was to characterize this species preferred environment. For this project, it was hypothesized that environmental parameters found on reefs with *M. dilatata* are not different from parameters on reefs without *M. dilatata*. This was true for temperature, pH, salinity, and colony size. Rugosity and water depth did however show significant differences between the reefs.

Rugosity refers to habitat complexity; this could include the heterogeneity of a habitat or its physical architecture (Sebens, 1991). With high rugosity and therefore increased complexity, an area will have a more complex structure of various forms (Sebens, 1991). Reefs with high complexity have been shown to provide many possible niches and have higher species diversity, richness, and fish biomass (Almany, 2004; Gratwicke & Speight, 2005; Friedlander & Parrish,

1998). Rugosity was significantly greater on reef 44 than on reefs 46 and 47 (Fig. 2). These results show that reef 44 has the most complex structure providing more niches for unique species. In addition, the significant findings suggest that habitat complexity does not have an influence on where *M. dilatata* is found.

Montipora capitata and *Porites compressa* were the largest biotic contributors to the community structure within the sampling areas. These two corals are most likely competing for space with *M. dilatata*. Reef 44 was found to have the highest coral cover, where *P. compressa* was the most abundant community contributor (Fig. 3). In contrast, the sampling areas on reefs 46 and 47 were composed of more non-living community components, e.g. rubble and sand. In addition, *M. capitata* was observed to be the most dominant coral at these two reefs. Small colonies of *M. dilatata* were observed around one *M. dilatata* colony on reef 44 and also around two of the colonies on reef 47 (Fig. 3). *Montipora dilatata* may have a stronger advantage for spreading on reef 47 because of the increased available substrate. The population of *M. dilatata* in Kāneʻohe Bay is thought to be decreasing (NOAA, 2007), so future surveys of the community composition surrounding the colonies on reefs 44 and 47 would provide informative data on the ability of this coral to expand its current range.

Salinities between the three studied reefs were not significantly different from each other. Salinities on the reefs studied this year (2014) had a narrow range from 33.00 ‰ to 34.00 ‰. In 2012, the Biology 403 class measured salinities on reefs with and without *M. dilatata*, finding a significant difference between salinities on reefs with and without the coral species (Gibo et al., 2012). Mean salinity on reefs with *M. dilatata* was 35.00 ± 0.40 ‰, significantly lower than the reef without. This was unexpected because low salinity has been demonstrated to be an environmental stressor for corals (Faxneld et al., 2010; Williamson et al., 2011). The salinity found

this year on reefs with *M. dilatata* was even lower with an average of 33.7 ‰. The average salinity in Kāneʻohe Bay has previously been higher than 35.3‰ than in the months during which this study was conducted (Jokiel, nd.). This lowered salinity on reefs which have *M. dilatata* colonies may indicate this species of coral has a high tolerance for low salinity.

The temperature on the three reefs surveyed did not differ significantly. The range of temperature was from 24.64 °C to 29.95 °C for all three reefs over a 48 hr period (7/20/14 - 7/22/14). This range was similar to temperatures found at reefs with *M. dilatata* colonies in 2012 (Gibo et al., 2012), with an average temperature of 26.57 ± 0.45 °C. Based on the close proximity of these three reefs, it is unlikely that a temperature difference between the reefs would be great enough to impact the presence of *M. dilatata*.

The depth measured at reef 44 was significantly lower than reef 47, but it was not significantly different from reef 46. However, the range of depths measured at reefs 46 and 47 was comparatively similar. Reefs 44 and 46 both had minimum depths greater than 1.3 m, whereas reef 44 had the lowest minimum depth of 0.98 m. Although these results contain a significant difference, it is unlikely that *M. dilatata* prefers a unique depth within the shallow range that most corals prefer.

The mean sizes of *M. dilatata* colonies on reef 44 were not significantly different from those on reef 47. The largest colony was found on reef 44 (8.4 m); however, the range of colony sizes between the two reefs was relatively close. There were no significant results regarding pH between any of the reefs however, it would be beneficial to observe pH changes over time. Climate change with increased atmospheric CO₂ has been shown to lower the pH in the ocean (Jokiel, 2011). Studies have shown that lower pH decreases corals ability to produce their calcium carbonate skeleton attributed to higher hydrogen ion concentration in the seawater with

consequent decrease in the corals removal of H^+ (Jokiel, 2011). This may affect colony growth and size in the future.

There were several major field problems that occurred throughout this experiment. One of the major issues was that midway through sampling a flash flood in the area caused a freshwater kill and a brown water advisory for Kāneʻohe Bay. A brown water advisory is issued when heavy rains cause flooding, in this case bringing raw sewage into the bay. This caused several of the corals, particularly around reef 46, to be decimated along with other native fauna. This event could have caused mortality of numerous corals recorded before the flash flood. Both bleaching and algal overgrowth were observed at all three of the reefs which were surveyed for this study. Freshwater kills and pollution are known factors of decline in *M. dilatata* populations (NOAA, 2007). Future research should include documenting reef damage from the freshwater kill in the area. Another issue encountered was that a previous class found possible *M. dilatata* colonies on reef 46 (Barlow et al., 2010), but their identification could not be genetically confirmed. Our team visually observed these colonies to be morphologically similar compared to the *M. dilatata* colonies on reefs 44 and 47. This questions the validity of the results because *M. dilatata* could potentially prefer all three study sites negating the comparison between reefs with and without *M. dilatata*.

Despite the issues encountered, this research was important not only to determine *M. dilatata*'s preferred environment, but also to see how it survived following a freshwater event. For most of the parameters tested, there was no significant difference between the three reefs surveyed. This indicates that reef 46 may be a conducive environment for the survival of *M. dilatata*, providing evidence that the unconfirmed colonies previously found at reef 46 are of the same species as colonies on reef 44 and 47. Assuming there is little to no difference among reefs

44, 46, and 47, we can characterize the preferred environment of *M. dilatata* based on the factors that were measured at the three reefs. According to results found in this experiment, *M. dilatata* in Kāneʻohe Bay prefers an environment that includes shallow waters of less than three meters, salinity levels between 33 and 34 ‰, pH between 8.2 and 8.4, and an average temperature of approximately 27 °C. The rugosity index showed the greatest difference between the reefs which may be an indication that *M. dilatata* has little preference for topographic complexity. Future research to further substantiate these results would be to study the attributes of Northern Kāneʻohe Bay in comparison to other parts of the bay. This research could also be broadened to include nearshore environments on Oʻahu. Such research could be expanded to include turbidity, mixing within the water column, and water flow. The results found in this study may have been confounded by factors that occur on a global level such as ocean acidification and climate change. It is important however to understand the local trends for factors surrounding *M. dilatata*, so that its status as a SOC can be properly assessed and carefully managed. Knowledge gained from this study can serve as a foundation for future research to base management decisions upon.

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Supplementary Materials

Table 2. The endpoints of each of the transects conducted.

Colony	Latitude	Longitude
12	21.47712	-157.83168
12	21.47695	-157.83168
12	21.47704	-157.83180
16	21.47772	-157.83217
16	21.47759	-157.83221
16	21.47773	-157.83228
14	21.47746	-157.83191
14	21.47732	-157.83192
14	21.47743	-157.83203
3	21.48099	-157.83266
3	21.48088	-157.83261
3	21.48088	-157.83276
15	21.48160	-157.83293
15	21.48173	-157.83296
15	21.48164	-157.83307
30	21.48129	-157.83347
30	21.48120	-157.83340
30	21.48119	-157.83356
Random Point 1	21.47942	-157.83430
Random Point 1	21.47952	-157.83429
Random Point 1	21.47938	-157.83421
Random Point 2	21.47930	-157.83386
Random Point 2	21.47918	-157.83397

Random Point 2	21.47917	-157.83383
Random Point 3	21.47945	-157.83324
Random Point 3	21.47930	-157.83313
Random Point 3	21.47933	-157.83327